

# DEMAND SIDE FLEXIBILITY IN UK UTILITIES

TRANSFORMING THE POWER SYSTEM BY 2030

AN EXCLUSIVE RESEARCH REPORT

**UtilityWeek**<sup>™</sup>

— In association with —

**CGI**



Imagine a future where electrical appliances are turned on and off automatically according to the availability and price of power; where electric vehicles charge overnight and act as mobile batteries; where major energy consumers see the rewards of providing demand-side response as a significant revenue stream. This future, according to current policy thinking, should be just 13 years away.

There is no doubt about the need to transition to a flexible energy system by 2030. It's the only way to deal with the intermittent, inflexible renewable sources of energy coming on to the grid, the increased demand for power arising from the electrification of heat and transport, as well as population growth and demographic changes. Key to the transition will be the widespread adoption of demand-side flexibility (DSF), incorporating demand-side response (DSR) and demand-side storage (DSS).

In the second piece of a major series of research reports delving into the industry's views on and experience of this transition, Utility Week and CGI have established the scale of the challenge ahead. This research reveals a DSF market in its infancy. While energy market participants are enthusiastic about DSF, and already engaged where possible, the policy, regulatory and market barriers it faces are significant.

As part of this research, Utility Week and CGI hosted a working party on DSF. Three groups of participants attended – suppliers, networks and aggregators.

**“ While energy market participants are enthusiastic about DSF, policy, regulatory and market barriers are significant. ”**

Ellen Bennett

Speaking amongst themselves, it was fascinating to see how the suppliers focused on the what the networks needed to do differently to enable a more flexible system. The aggregators focused on problems with the suppliers, particularly with the vertical integration model. The networks, meanwhile, focused on engineering challenges and how to provide system resilience.

As well as providing some insight into the collective character of each group, the experience showed how communication and co-operation is one of the main challenges the market faces. While government must do its part to overcome the policy and regulatory barriers, market participants themselves would do well to break down their established thinking and see the challenges from one another's perspectives. Together, they can then work towards a solution. Time is short.

Ellen Bennett, editor, Utility Week



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**The need for a more flexible power system has been widely accepted. As renewable generation takes over from traditional power sources, the grid has to cope with inflexible, intermittent generation, as well as the challenges created by distributed generation. Once a one-way power delivery channel, the electricity grid must evolve to deal with the increasing complexity of the system, capable of compensating for the flexibility lost from generation, coping with two-way power flow, and balancing at a local level.**

In 2016, Utility Week and CGI partnered on a major piece of market research looking at the issue of flexibility. This established the significance of flexibility

and provided an overview of the three main routes to achieving it: demand-side flexibility (DSF), storage and interconnection. This follow-up study explores the issue of DSF in greater depth. For the purposes of this study, DSF is defined as demand-side response (DSR) plus associated measures such as demand-side storage (DSS).

First, to reprise the results of the first study, our respondents were clear on the need for a step change on flexibility in the power system, suggesting it needs to double by 2030, and rating its strategic significance at 9.1 out of a possible 10 at that time. They highlighted DSF as the most important aspect of flexibility. (See box on page 6 for the key findings.)

In this follow-up study, we asked stakeholder groups within the energy

**“ While there has been some early participation in DSF projects, the benefits they have yielded have been largely around economic returns for customers. ”**

sector for their views on the potential of DSF; their experience of DSF projects to date; the barriers they have encountered; the attitudes of their customers; and their future outlook with regard to DSF.

The research revealed a market in its infancy. Much is expected of DSF, as one of the main planks of a more flexible power system. Comparatively little has been delivered. All agree on the benefits that may arise from DSF, but they have yet to materialise, with regulatory and economic barriers putting a significant constraint upon activity.

While there has been some early participation in DSF projects, the benefits they have yielded have been largely around economic returns for customers and, to a lesser extent, for businesses. While these are useful proofs of concept, the potential benefits judged greatest by our respondents – those of cutting peak energy demand and helping to balance the grid as the energy mix changes – have been less apparent to date.

## Key findings:

### POTENTIAL OF DSF

- There is no doubt about the significance of DSF to energy businesses and the UK as a whole, with respondents rating it at 8.7 out of 10 for their businesses and 9.1 for the UK, by 2030. These figures represent an anticipated rise in significance of around one-third over the next 13 years.
- The biggest anticipated benefits of DSF are its ability to cut peak energy demand, maintain system balance and create flexibility to compensate for inflexible sources of generation.

## TOWARDS A DSF MARKET

- More than half (57 per cent) of businesses are adopting a limited or cautious approach to DSF.
- Suppliers are the least enthusiastic, with 22 per cent not seeing DSF playing a significant role in their business's strategy in the foreseeable future.
- Of those businesses that have engaged in early DSF projects, Distribution Network Operators (DNOs) have seen the most success. Traders and flexibility providers rated success levels significantly lower than participation levels, suggesting results have not lived up to expectations.

- DSF has yet to play a significant role in the energy mix, with only 28 per cent of projects to date resulting in reduced energy demand, and 32 per cent in reduced pressure on infrastructure or reduced requirement for new infrastructure.

## BARRIERS TO DSF

- The majority of respondents (82 per cent) have experienced barriers to the success of their DSF projects to date, with economic barriers the most common.
- The lack of incentives was highlighted as a significant barrier, with respondents selecting it as both the biggest regulatory and economic hurdle.
- Respondents identified a lack of policy and regulatory clarity around DSF, ranking it just 4.2 out of a possible 10.
- Confidence in the forthcoming regulatory reforms around DSF is low, with respondents rating their confidence that the reforms will remove the barriers to DSF at just 5 out of a possible 10.

## CUSTOMERS AND DSF

- An uptick in customer appetite for DSF is expected around 2024, with domestic customers' appetite predicted to rise 64 per cent by then, and SMEs 50 per cent. It is expected to remain highest among industrial and commercial (I&C) customers.
- The lack of adequate price incentives is seen as the main barrier to non-domestic take-up of DSF by 63 per cent of respondents.
- Lack of awareness is the biggest barrier to domestic take-up of DSF in the future, as more opportunities become available, according to 73 per cent of respondents.

- More than half (54 per cent) of respondents believe consumers are not adequately protected in the market as it stands.
- Vulnerable customers could be disadvantaged by the transition to a flexible power system, and should be protected by the regulatory system, our respondents believe.

## TECHNOLOGY AND DSF

- Energy storage for commercial customers is the most important technology to the development of DSF, at 7.5 out of a possible 10.
- More important than any particular technology was increased awareness of and accessibility to the DSF market for I&C customers.



“ DSF has yet to play a significant role in the energy mix, with only 28 per cent of projects resulting in reduced energy demand, and 32 per cent in reduced pressure on infrastructure or requirement for new infrastructure.”

For the energy sector, a number of things must happen before the potential benefits of DSF can become a reality.

Our respondents expected a major uptick in consumer interest around 2024, which is widely expected to be a tipping point in the move towards a more flexible power system.

In the meantime, despite the undisputed potential benefits of DSF, it remains an unproven and immature market that needs considerable development before reaching mass penetration. Customers are likely to remain largely unaware of its potential role, and market participants that understand its future significance are left to jockey for position and seek to influence decision makers as its future structure is decided and enshrined in legislation and regulation.



**T**he transformation of the UK's power infrastructure to a more flexible, responsive system is arguably the most important issue facing the energy industry today. Last year, Utility Week and CGI formed a partnership to investigate this critical issue in greater depth, launching with a

major piece of market research that established the significance of flexibility and provided an overview of the three main routes to achieving it: demand-side flexibility (DSF), storage and interconnection. This is a follow-up study exploring the issue of DSF in greater depth. For the purposes of this study, DSF is defined as demand-side response (DSR) plus associated measures such as demand-side storage (DSS).

First, to reprise the results of the first study, our respondents were clear on the need for a step change on flexibility in the power system, suggesting it needs to double by 2030, and rating its strategic significance at 9.1 out of a possible 10 at that time (see box for the full key findings). They highlighted DSF as the most important aspect of flexibility.

To build on the findings of the 2016 study, Utility Week and CGI have partnered on this second piece of research, which looks in greater depth at the degree to which industry has already made use of DSF; its experience to date; customers' experience of and appetite for DSF; and the regulatory, economic and technological barriers that have yet to be overcome.

The research was conducted in spring 2017 with five key audience groups:

- ❑ Distribution Network Operators (DNOs)
- ❑ Energy suppliers
- ❑ Energy traders
- ❑ Aggregators
- ❑ Flexibility providers

## KEY FINDINGS 2016

- ❑ Respondents believed that the level of flexibility in the power system needs to more than double within the next 14 years, from a current level of 4 out of a possible 10 to 8.4 by 2030.
- ❑ There was little doubt of the strategic significance of flexibility by 2030, rated at 9.1 out of a possible 10.
- ❑ The key drivers for greater flexibility in the power system are:
  - ❑ Constraints management
  - ❑ New business opportunities
  - ❑ Balancing the system
- ❑ DSF was seen as the most important aspect of flexibility.
- ❑ The greatest opportunities arising from flexibility in the power system are:
  - ❑ DSF:
    - ❑ DSF sharing between DNOs and the system operator
    - ❑ Selling industrial and commercial DSF
    - ❑ The creation of a central market platform for trading DSF
  - ❑ Storage:
    - ❑ The ability to manage intermittent generation patterns and demand variability
    - ❑ Grid stability services
    - ❑ The ability to provide an alternative to traditional network performance
- ❑ The greatest barriers to flexibility in the power system are:
  - ❑ DSF:
    - ❑ Lack of a commercial/market framework to optimise DSF
    - ❑ Commercial and regulatory barriers in the existing market arrangements for DSF
    - ❑ Policy framework
  - ❑ Storage:
    - ❑ The cost of storage solutions
    - ❑ The structure of balancing services
    - ❑ The classification of storage as a generation activity
- ❑ There was a strong belief that interconnection will play a significant role in energy security by 2030, with 82% of respondents agreeing.

A number of other respondents including transmission network operators were also included (see box on page 8 for full methodology).

Utility Week and CGI also convened a working group of senior individuals from the above energy segments in March 2017. Insight from the group is included throughout the report.

## Policy background

The significance of flexibility in general and DSF in particular has been recognised at all levels of government, and has moved up the political agenda since our first study in 2016, thanks in part to a series of studies including the National Infrastructure Commission's

review, which identified up to £8bn of annual savings that could arise from a more flexible power system.

The numerous barriers to system flexibility highlighted in our 2016 study have been recognised by government, which launched a consultation in November 2016 examining the possible means of removing them. The smart systems Call for Evidence, which closed in January 2017, asked industry for its views on the best means of facilitating greater uptake of storage and DSF (see box). Ministers are currently reviewing the many responses received to the consultation, and are expected to respond after the June 2017 general election. This response will take the form of a roadmap for change, setting out further action over the months and years ahead.

“The barriers to system flexibility have been recognised by government, which launched the smart systems Call for Evidence asking industry for its views on facilitating greater uptake of storage and DSF.”

## THE SMART SYSTEMS CONSULTATION

The long awaited smart systems consultation released in late 2016 is seen as the potential catalyst for technological and market innovation, enabling transformation and ushering in a more flexible power system.

In reality, Ofgem has been consulting on the future for some time. In 2015 it issued a position paper on flexibility. Before that it had consulted on the transformative potential of non-traditional business models and their challenges, risks and opportunities.

Now the focus is on where regulatory change or space for innovation is needed. The Smart, Flexible Energy System call for evidence identifies four main areas of work necessary to build a system capable of cultivating innovation and meeting the changing demands of customers: removing barriers to storage and demand-side response; improving price signals to allow more flexibility; catalysing innovation; and assessing changes to roles and responsibilities in the energy system.

Energy minister Greg Clark says that both the government and Ofgem “ask open questions about these strategic choices”, but Ofgem has ignored calls to allow DNOs into the storage arena. Instead, it has pushed forward a vision of competition despite voices of doubt from the industry on whether a truly competitive market for storage is possible.

Little in the call for evidence is a revelation. As expected, energy storage sees the full range of known barriers addressed and potential solutions given. But some less discussed areas have also been singled out for attention, such as the role of aggregators, low-emission vehicles and cyber security.

Previous work by Ofgem has identified a range of barriers preventing aggregators from delivering smart technology and processes, and the consultation aims to address these. They include selling services to the system operator and accessing the balancing mechanism. There could be some further issues, including cross-party impacts in the energy market, aggregated actions that impact



on the secure operation of a local or national system, and consumer protection risks.

The paper also recognises the potential risks of allowing the ultra low-emission vehicle market to evolve without some guidance. Ultra low-emission vehicles, such as those based on electric and hydrogen fuel cell technologies, are critical to meeting carbon reduction targets and tackling air pollution.

But the paper states that “without any intervention, there is a risk that electricity demand to support these vehicles could add to existing demand peaks, triggering expensive network reinforcements and a need for additional peak generation capacity”. It says there is the “opportunity to help shape norms, expectations and markets so that electric vehicles are integrated” in the most cost-effective way possible.

The government has said little before this on the role it could play in the development of this important sector. But it is now calling for views on how it and industry should bring forward smart charging propositions for consumers.

A smart system inevitably means a more interconnected and digital system, opening the door to security issues. The paper makes it clear that building security into any solution will be a fundamental priority. It will potentially be the first time the energy system receives major guidance on how to implement cyber security.

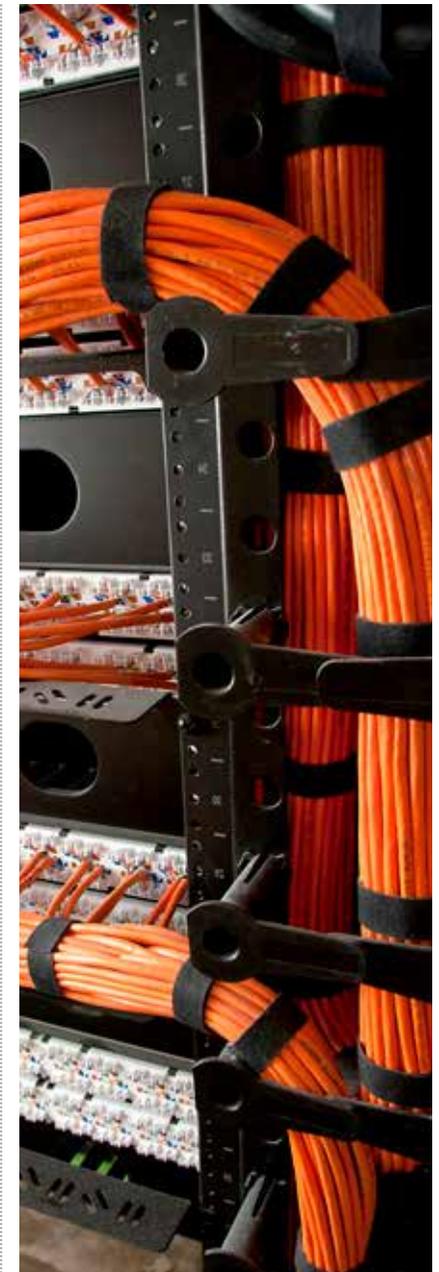
*This is a version of an article that first appeared in Utility Week in December 2016.*

Figure 1

## Call for Evidence on Smart Energy

<b>Removing barriers to storage and DSR</b>	<ul style="list-style-type: none"> <li>Clarify role of aggregators.</li> <li>Explore the need for policy intervention and regulatory oversight.</li> <li>Evaluate and address barriers to ownership and utilisation of storage.</li> </ul>
<b>Improving price signals</b>	<ul style="list-style-type: none"> <li>Consider ways in which we can encourage and reward consumers to offer their flexibility (ie half-hourly settlement, smart appliances, etc).</li> </ul>
<b>Catalysing innovation</b>	<ul style="list-style-type: none"> <li>Ensuring the government's innovation finding supports those areas critical to the development of a smart energy system, including evaluating the public sector's role in supporting smart.</li> </ul>
<b>Making sure flexibility providers can compete fairly</b>	<ul style="list-style-type: none"> <li>Considering how flexibility providers can compete fairly against incumbents in existing markets and in missing markets (for example in managing local network constraints), and can stack value across these markets.</li> </ul>
<b>Assessing changes to roles &amp; responsibilities</b>	<ul style="list-style-type: none"> <li>Considering what institutional and market frameworks may be required in a future smart energy system to maximise benefits while managing the risks; and how roles and responsibilities may need to change in light of these (e.g. from DNO to DSO).</li> </ul>

Source: The Department for Business, Energy and Industrial Strategy



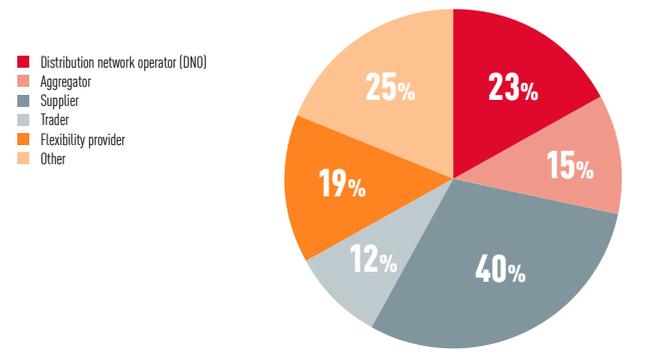
## METHODOLOGY AND NUMBERS

This survey was carried out by an independent, accredited market research agency on behalf of Utility Week and CGI. Senior individuals at the UK's major energy companies and new entrants, DNOs and aggregators were asked to complete an online survey between March and April 2017. There were 52 confidential responses, which were viewed only by the market research agency, with the resulting data presented in this report in an aggregated and anonymised form.

90% of respondents were managers or more senior; and 50% were chief or head of department or more senior. All the DNOs were represented in the responses, as were five of the six major energy suppliers.

Figure 2

## Type of business that took part in the survey





## Our research first set out to establish the importance of DSF to businesses in the energy sector in particular, and to the UK in general.

Our respondents were clear on the importance of DSF to their businesses, now and increasingly in the future. Asked to rate the importance today on a scale of 1 to 10, respondents scored it average of 6.7, rising 30 per cent to 8.7 by 2030.

Breaking down the responses by group reveals some interesting variations. It is little surprise that aggregators rate the importance of DSF to their business the highest, at 9.9 both today and in 2030. Suppliers and traders rate the importance of flexibility the lowest, at 5.1 and 5.3 respectively today, rising to 7.7 for suppliers and, interestingly, to 9 for traders by 2030. This suggests that traders see significant potential for the development of a market for DSF, and opportunity for their businesses within that.

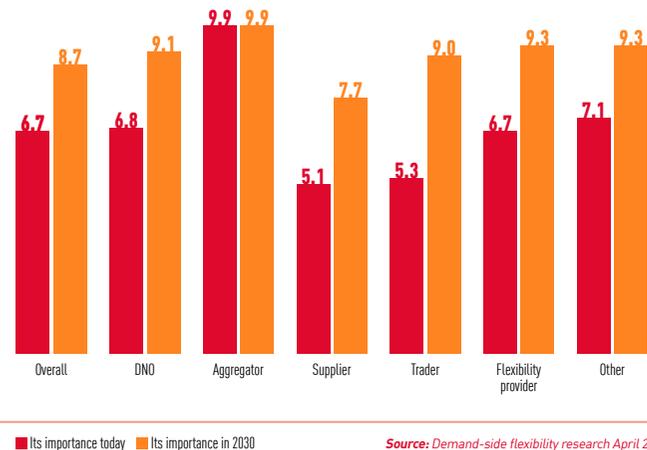
## KEY FINDINGS

- There is no doubt over the significance of DSF to energy businesses and the UK as a whole, with respondents rating it at 8.7 for their businesses and 9.1 for the UK, by 2030.
- These figures represent an anticipated rise in significance of around one-third over the next 13 years.
- The biggest anticipated benefits of DSF are around its ability cut peak energy demand, maintain system balance and create flexibility to compensate for inflexible sources of generation.

Figure 3

Q: How important is DSF to your business, now and in the future?

Average rating out of 10 (10=Extremely important)



Source: Demand-side flexibility research April 2017

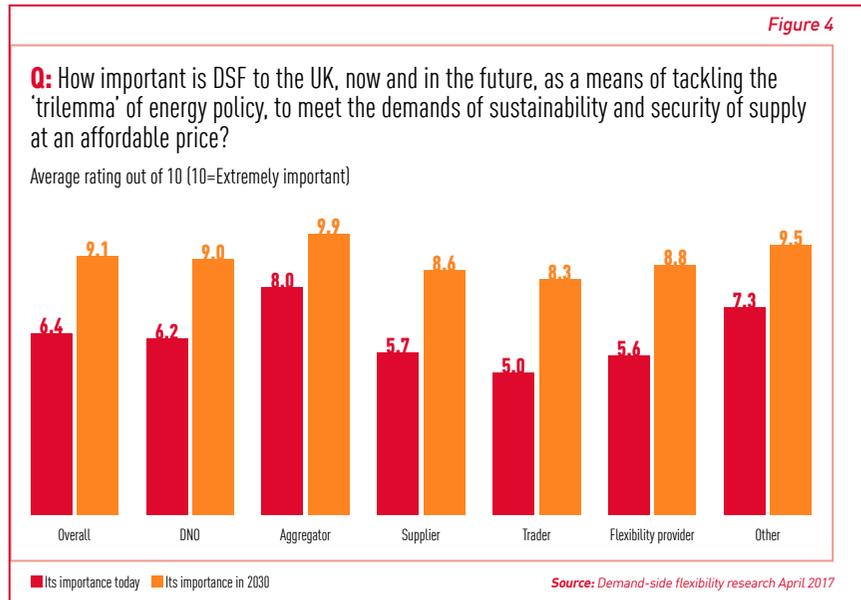
Our respondents were also asked to rate the importance of DSF for the UK as a means of tackling the energy 'trilemma' of sustainability, affordability and security of supply, today and in the future. Today, they responded, the importance of DSF is 6.4 out of a possible 10, rising to 9.1 by 2030 – ranking its importance for the UK as a whole above its importance for individual businesses. This makes it clear that our respondents believe DSF has a critical role to play in resolving the energy trilemma.

Once again, aggregators were most enthusiastic about the importance of DSF, rating it 9.9 out of a possible 10. It is interesting that DNOs were not far behind, with 9 out of a possible 10, the second highest response. Traders, who as

“ Our respondents believe DSF has a critical role to play in resolving the energy trilemma. ”

# THE POTENTIAL OF DSF

a group were clear on the potential of DSF for their own businesses, were more muted about its importance for the country as a whole, coming in the lowest of all the groups of respondents, though showing the greatest increase from today to 2030.



## Benefits of DSF

Respondents were asked to rate a number of potential benefits arising from DSF, scoring them out of a possible 10. Their answers acknowledged a broad range of benefits, with even the lowest scoring benefit, that of keeping customers' bills affordable – coming in at 7.3.

The biggest potential benefit identified by respondents was the ability of DSF to reduce peak energy demand, at 8.4 out of 10. Not far behind was its potential to maintain system balance and in third place was its ability to compensate for the flexibility lost in the system by the move to renewable, intermittent power sources.

The potential economic benefits of DSF were ranked the lowest, with its potential to mitigate the need for investment in transmission and distribution capacity, in generation capacity, and to keep customers' bills affordable coming bottom of our table, though still with fairly high scores of 7.5, 7.4 and 7.3. This may suggest that some respondents are yet to be convinced that demand-side measures could replace investment in new capacity.

Figure 5

**Q:** How would you rate the potential of each of the following benefits of DSF?

Average rating out of 10 (10=Extremely important)



Source: Demand-side flexibility research April 2017

“ It was felt that early movers in the provision of demand-side services will gain commercial advantage.”

## WORKING PARTY ON DSF

At a working party of DNOs, energy suppliers and aggregators held by Utility Week and CGI in London in March 2017, each group was asked to identify the potential of DSF – or the 'size of the prize'.

Energy suppliers agreed that the 'size of the prize' could be significant, though the nature of the prize was more focused on system value than on commercial gain. It was felt that early movers in the provision of demand-side services will gain commercial advantage, but that the political environment around energy supply currently makes it unacceptable for energy firms to admit much interest in the possibility that demand-side services might be lucrative for them.

It was also observed that the 'size of the prize' associated with DSF is dependent on the uptake of key technologies such as electric vehicles (EVs), and to a lesser extent electric heat. It will also depend on the development of local energy systems and the Distribution System Operator agenda.

Suppliers agreed that DSF had a major role to play in tackling the 'energy trilemma', because it can flatten demand and drive towards an overall reduction in demand, meaning less requirement for new capacity of peaking plants and facilitating the use of renewable energy sources.

There are risks as well as benefits attached to DSF, as our working party was keen to highlight. DNOs were particularly cautious, warning that public attitude towards risk will have to change if DSF is to succeed – automatic technologies tend to have a higher risk of failure.

The DNOs also commented that DSF provides options. For example, with EVs, DNOs can either do £15m of reinforcement, or do some DSF and wait and see for five years where the investment is really needed. However, they warned that this capacity to 'buy time' risked exacerbating problems rather than solving them.



## KEY FINDINGS

- More than half (57 per cent) of businesses are adopting a limited or cautious approach to DSF.
- Suppliers are the least enthusiastic, with 22 per cent saying they do not see DSF playing a significant role in their business's strategy in the foreseeable future.
- Of those businesses that have engaged in early DSF projects, DNOs have seen the most success. Traders and flexibility providers rated their success levels significantly lower than their participation levels, suggesting results have not lived up to their expectations.
- DSF has yet to play a significant role in the energy mix, with only 28 per cent of projects to date resulting in reduced energy demand, and 32 per cent in reduced pressure on infrastructure or reduced requirement for new infrastructure.

**W**hile there is clear recognition of the potential of DSF to play a role in the energy market, the technology and its application are still in their early days. We asked our respondents about the degree to which they have engaged in DSF projects to date, and the results when they have.

The responses demonstrated that a majority of businesses are taking a limited or cautious approach to DSF. Overall, 57 per cent of respondents gave a cautious response, saying either they do not expect DSF to play a significant role in their business's future (9 per cent); the role it plays will depend on the extent to which regulatory and market barriers are

removed (24 per cent); or that DSF will have an important role in the future but plays a limited extent for the next three to five years (24 per cent).

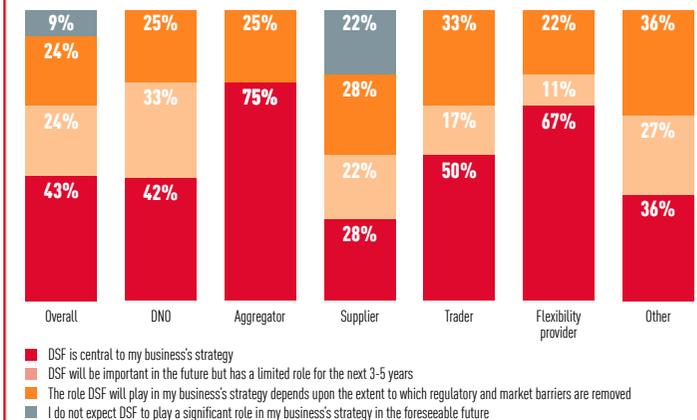
Breaking down the response by respondent group, there is considerable variation in the approach taken to DSF. Unsurprisingly, aggregators were once again the most enthusiastic, with 75 per cent saying it was central to their business strategy and the remaining 25 per cent saying its role would depend upon the removal of regulatory and market barriers. A relatively high proportion (42 per cent) of DNO respondents said DSF was already central to their business strategy, with the remainder saying it would be important in the future but have a limited role in

the next three to five years (33 per cent); or that its role depends on the extent to which regulatory and market barriers are removed (25 per cent).

Once again, suppliers were the least enthusiastic group, with a significant minority (22 per cent) who did not expect DSF to play a significant role in their business's strategy in the foreseeable future. However there was wide variance within this group, with 28 per cent saying it already did play a significant role, 22 per cent saying it would do in the future but not for the next three to five years, and 28 per cent saying it depends on the removal of market and regulatory barriers. This perhaps reflects the open market nature of the supplier industry, and its participants' differing strategies.

Figure 6

**Q:** Which of the following best describes your business's strategy with regards to DSF?



Source: Demand-side flexibility research April 2017 NB where figures do not add up to 100, this is due to rounding

Given the relative immaturity of the DSF market and the barriers to its full deployment, it was interesting that respondents rated their current participation in DSF projects at an average 6.3 out of a possible 10. Once again, aggregators and flexibility providers were the most involved at 8.8 and 7.9 respectively. Traders scored their involvement highly at 7.8 out of 10, suggesting the market barriers that exist are not blocking all activity, and suppliers were once again the laggards at 5.4.

Respondents were also asked to score the success of the DSF projects they had participated in to date, and there were some interesting contrasts. While aggregators' high success score of 8.4 reflected their high participation score of 8.8, other groups that had high participation reported more limited success. The biggest contrast was for traders, who scored their participation at 7.8 but success at just 5.3, reflecting the market barriers that have yet to be resolved. Flexibility providers scored their participation at 7.9 and their success at just 6.2, again suggesting that systemic blocks are preventing the value of flexibility from being fully realised.

Figure 7

**Q:** To what extent has your business participated in DSF projects?

**Q:** Thinking about the DSF projects your business has participated in, how successful have they been?

	Average extent of participation (10 = Full participation)	Average success rating (10 = Extremely successful)
Overall	6.3	6.7
DNO	7.6	7.5
Aggregator	8.8	8.4
Supplier	5.4	5.5
Trader	7.8	5.3
Flexibility provider	7.9	6.2
Other	5.2	5.4

Source: Demand-side flexibility research April 2017

Experience was mixed with regard to the successful outcomes that had been achieved to date. The clear winner was financial return for end customers, although with 46 per cent of respondents selecting this option, its success was not overwhelming. A lower proposition (32 per cent) had seen a financial return for their own business,

and surprisingly low proportions reported reduced pressure on infrastructure or demand for new infrastructure (32 per cent); and just 28 per cent reported reduced energy demand. These figures reflect a market still in its infancy and suggest there are a number of practical issues around the use of DSF that have yet to be resolved.

However, when the responses to this question were broken down by respondent type, DNOs were significantly more likely to report reduced pressure on infrastructure, at 75 per cent, with the average being pulled down by suppliers, who scored it at just 15 per cent, reflecting the different nature of the respondents' businesses.

Figure 8

**Q:** What, if any, have been the most successful outcomes of the DSF projects your business has worked on to date?

Financial return for end customers	46%
Financial return for your business	32%
Reduced pressure on infrastructure/reduced requirement for new infrastructure	32%
Reduced energy demand	28%
Other	20%
Not seen any successful outcomes	16%

Source: Demand-side flexibility research April 2017

## SUCCESSFUL OUTCOMES OF DSF PROJECTS

- “Our projects have achieved their goals very well, but we are limited in what we can do because of regulatory barriers.”
- “Insight into customer behaviour.”
- “Integration of intermittent renewable sources of generation.”
- “Learning how to do something new.”

“ Respondents scored the success of DSF projects they had participated in. The biggest contrast was for traders, who scored participation at 7.8 but success at just 5.3, reflecting barriers that have yet to be resolved.”





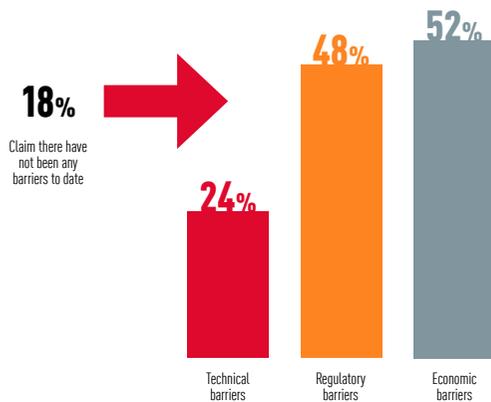
## KEY FINDINGS

- ❑ The majority of respondents [82 per cent] had experienced barriers to the success of their DSF projects to date, with economic barriers the most common.
- ❑ The lack of incentives was highlighted as a significant barrier, with respondents selecting it as both the biggest regulatory and economic hurdle.
- ❑ Respondents identified a lack of policy and regulatory clarity around DSF, ranking in just 4.2 out of a possible 10.
- ❑ Confidence in the forthcoming regulatory reforms around DSF is low, with respondents rating their confidence that the reforms will remove the barriers to DSF at just 5 out of 10.

**R**espondents were asked to identify the barriers to success in the DSF projects in which they have participated (see box). While a notable minority (18 per cent) claimed there had not been any barriers to date, the majority had experienced economic, regulatory and, to a lesser extent, technical barriers. Economic barriers were the clear leader at 52 per cent, with regulatory barriers close behind at 48 per cent, and technical barriers apparently less common at 24 per cent.

Respondents were then asked to rate the degree to which they had experienced particular economic barriers, and particular regulatory barriers.

**Q:** What, if any, have been the major barriers to the DSF projects your business has worked on to date?

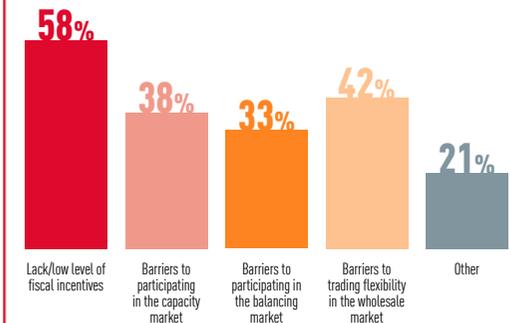


Source: Demand-side flexibility research April 2017

## REGULATORY BARRIERS

Respondents were asked what regulatory barriers to DSF projects their business had experienced to date. More than half identified the lack or low level of fiscal incentives, at 58 per cent. The second most commonly experienced barrier was to trading flexibility in the wholesale market at 42 per cent, with barriers to participating in the capacity market (38 per cent) and the balancing market (33 per cent), coming close behind.

**Q:** What regulatory barriers to DSF projects has your business experienced to date?



Source: Demand-side flexibility research April 2017

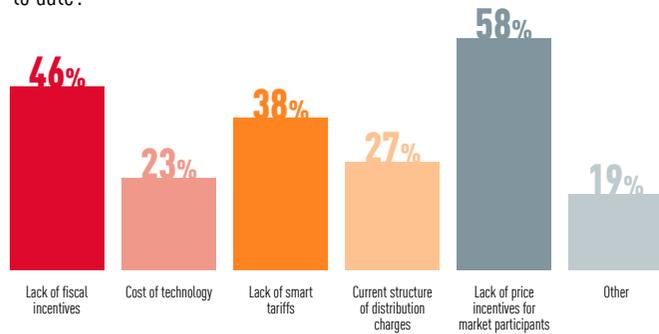
**“Economic barriers were the clear leader at 52 per cent, with regulatory barriers close behind at 48 per cent and technical barriers apparently less common at 24 per cent.”**

## ECONOMIC BARRIERS

The lack of incentives was cited as the most common economic barrier. 58 per cent of respondents highlighted the lack of price incentives for market participants as a barrier they had experienced; and 46 per cent identified the lack of fiscal incentives. Just 23 per cent cited the cost of technology as a core economic barrier, and 27 per cent the current structure of distribution charges.

Figure 11

**Q:** What economic barriers to DSF projects has your business experienced to date?



Source: Demand-side flexibility research April 2017

## WHAT ECONOMIC BARRIERS TO DSF PROJECTS HAS YOUR BUSINESS EXPERIENCED TO DATE?

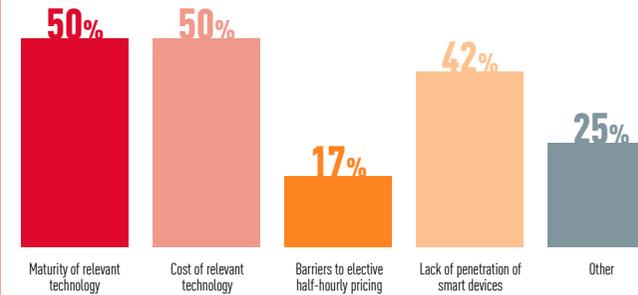
- ❑ "Bid bonds for capacity market with only one-year contract versus 15 years for generation."
- ❑ "The potential savings for customers today are relatively low."
- ❑ "Level of incentives required for consumers to change their behaviour."
- ❑ "Capacity market makes DSR less competitive by subsidising existing generation."
- ❑ "Gaining sufficient traction with the customer on price to enable them to move forward."

## TECHNICAL BARRIERS

Asked what technical barriers to DSF projects their business had experienced to date, equal numbers (50 per cent) selected the maturity of relevant technology, and the cost of relevant technology. The lack of penetration of smart devices was a smaller but still significant proportion at 42 per cent.

Figure 12

**Q:** What technical barriers to DSF projects has your business experienced to date?



Source: Demand-side flexibility research April 2017





## Regulatory reforms

Respondents were asked to rate their confidence in the regulatory reforms currently being considered, such as the government's smart systems call for evidence.

Confidence in the reforms is low, with respondents rating their confidence that the reforms will remove the barriers to DSF at just 5 out of a possible 10. Asked to what extent they felt there is currently policy and regulatory clarity about DSF, respondents replied an average of just 4.2 out of 10. And when asked to what extent they felt the government was working towards clarity, they answered just 5.5 out of 10. That DNOs had the highest

confidence level here at 6.9 perhaps reflects the focus of the smart systems Call for Evidence on regulatory reform that touches their businesses specifically, and the fact that they have taken a lead role in discussions around the market so far. Aggregators gave notably low scores, even against a low average, suggesting some frustration at the level of their influence with government.

- Q:** How confident are you that current regulatory reforms will remove the barriers to DSF?
- Q:** To what extent do you feel there is currently policy and regulatory clarity about DSF?
- Q:** To what extent do you feel that government is working to provide policy and regulatory clarity around DSF?

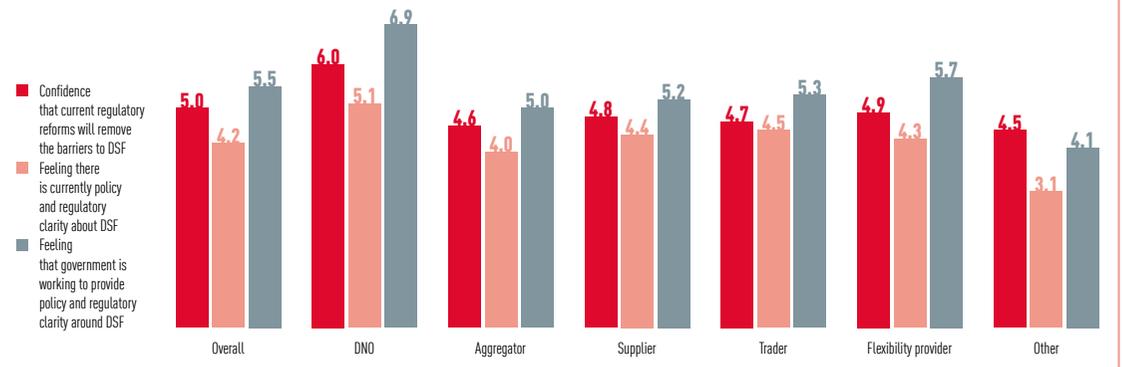


Figure 13

Source: Demand-side flexibility research April 2017

## WORKING PARTY ON BARRIERS TO DSF

Perceptions of the main barriers to DSF varied considerably by group at our working party, with each group tending to feel disadvantaged or misunderstood by the others, and by government and regulators.

Suppliers saw some fundamental contradictions between recent and ongoing government interventions in the supply market on behalf of consumers, and the need to motivate users to engage in DSF.

This observation linked to a discussion about the price signals and differentials between high peak and lowest costs of energy. It was – cautiously – agreed that DSF will only be enabled when there is a bigger

price differential and some also insisted that the peak price of energy will need to be higher in order to motivate customers to engage.

DNOs also called for clear political direction. They argued that the question of how much security should be in the system is one for politicians to decide. They also highlighted the lack of engagement with customers to date.

Aggregators argued that ministers do not fully understand DSF and how it works in practice. They highlighted capacity market rules which do not allow aggregators to make changes to the portfolio of DSF which makes up a capacity market unit.

Currently if one of the providers drops out, the whole contract becomes nullified. This fails to take account of providers changing their plans, often to take actions that are beneficial to the energy system such as installing energy efficiency measures.

Aggregators argued that suppliers had vested interests against DSF, with one going so far as to claim suppliers are engaged in a “whispering campaign” about the reliability of the approach.

Vertical integration is a major barrier to the success of DSF, they said, as it means suppliers have “no incentive to find an alternative to their generation”, and therefore cannot act as a “hero for the consumer”.



**D**iscussion of DSF and other means of flexibility often focuses on energy sector participants, but as the providers of flexibility, end users are crucial partners in DSF – and their engagement provides one of the biggest challenges to its take-up.

Our research shows that lack of awareness and understanding amongst the end customers presents challenges for the sector.

## NON-DOMESTIC CUSTOMERS

A majority of respondents believed that the lack of adequate price incentives is the main barrier to non-domestic take-up of DSF, with 63 per cent agreeing or agreeing strongly. Consumer awareness was also an issue, with 55 per cent of respondents agreeing or agreeing strongly that it was the main barrier. Customer concerns over autonomy and/or privacy and security were less pronounced than among domestic customers, with just 35 per cent of respondents agreeing or agreeing strongly that they are the main barrier to take-up for non-domestic customers.

## DOMESTIC CUSTOMERS

Lack of awareness was an even bigger issue among domestic customers, our respondents felt. 73 per cent agreed or agreed strongly that, while there were currently limited opportunities for domestic DSF, limited customer awareness would hamper the wider rollout of such opportunities in future. Concerns over autonomy and/or privacy and security were expected to be significant, with 61 per cent of respondents expecting them to hamper the rollout of DSF.

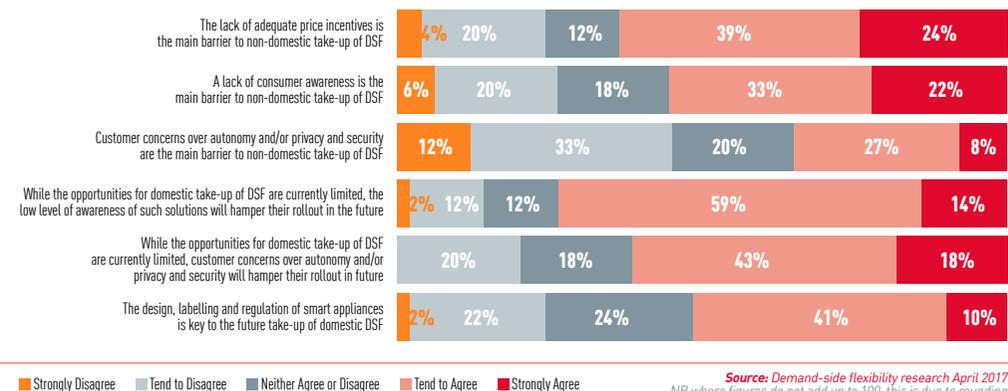
Opinion was divided over the role of smart appliances, with 51 per cent agreeing or agreeing strongly that their design, labelling and regulation is key to future take-up of domestic DSF and the remainder disagreeing or neither agreeing nor disagreeing.

## KEY FINDINGS

- An uptick in customer appetite for DSF is expected around 2024, with appetite among domestic customers predicted to rise 64 per cent by that time, and among SMEs 50 per cent. Appetite is expected to remain highest among I&C customers.
- The lack of adequate price incentives is seen as the main barrier to non-domestic take-up of DSF by 63 per cent of respondents.
- Lack of awareness is the biggest barrier to domestic take-up of DSF in the future, as more opportunities become available, according to 73 per cent of respondents.
- More than half (54 per cent) of respondents believe consumers are not adequately protected in the market as it stands.
- Vulnerable customers could be disadvantaged by the transition to a flexible power system, and should be protected by the regulatory system, respondents believed.

Figure 14

**Q:** To what extent do you agree or disagree with each of the following statements?



Respondents felt that customer appetite for DSF was set to rise, with the biggest leaps expected among domestic customers, rising from 2.8 out of a possible 10 today to a predicted 4.6 in 2024, and 6.3 by 2030.

Similar if slightly smaller leaps in customers' appetite were predicted among SME customers, with the rise less pronounced among I&C customers who, at 5.6 out of 10 for today's

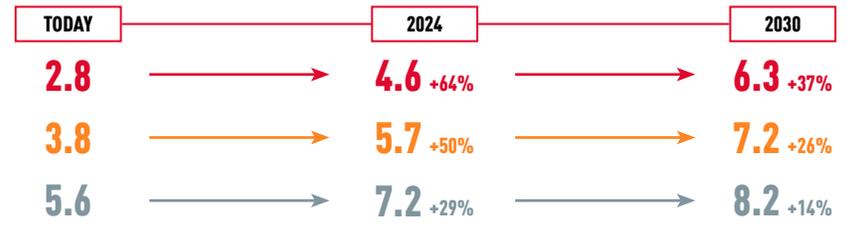
appetite, are starting at a higher base.

That said, appetite is predicted to remain highest among I&C customers at 8.2 by 2030, reflecting their potential for realising the most value from the market thanks to their higher energy demand.

**Q:** How would you rate the appetite for DSF amongst domestic customers?

**Q:** How would you rate the appetite for DSF amongst SMEs?

**Q:** How would you rate the appetite for DSF amongst industrial and commercial (I&C) customers?



■ Domestic customers ■ SMEs ■ I&C

Source: Demand-side flexibility research April 2017

## Customer protection

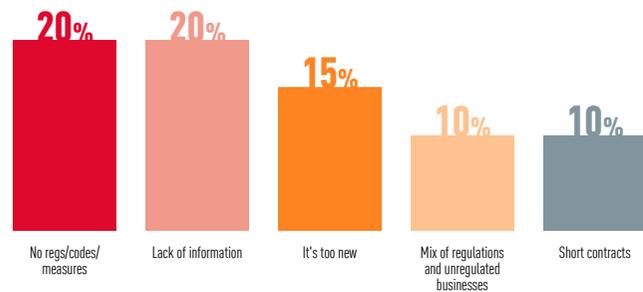
Energy is a vital commodity and, as well as engaging customers, the new market must afford them the same protection that is enshrined in the current market. Respondents were asked the extent to which they believe there are adequate measures in place to protect customers.

Opinion was divided, but a clear majority (54 per cent) believed there are not currently adequate measures in place. Of these, one-fifth cited concerns around a lack of regulations and codes, and the same number around a lack of information.

However, a notable minority (44 per cent) believed the market already had adequate measures in place

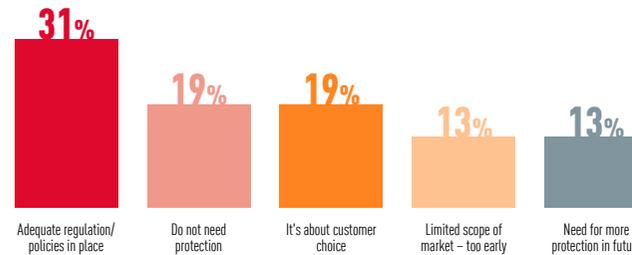
to protect customers. Of these, 31 per cent felt the necessary regulations or policies were already in place, while 19 per cent believed customers did not need protection and the same proportion felt, in similar vein, that the market should be about customer choice.

**Q:** Please can you outline your thoughts around why you believe that there are not adequate measures in place to protect customers in the DSF market?



Source: Demand-side flexibility research April 2017

**Q:** Please can you outline your thoughts around why you believe that there are adequate measures in place to protect customers in the DSF market?



Source: Demand-side flexibility research April 2017

## ARE THERE ADEQUATE MEASURES IN PLACE TO PROTECT CUSTOMERS?

- "There are adequate measures to protect customers in the current marketplace, but that will need to be reviewed going forward to ensure that new participants in DSF services are adequately managed/incentivised to provide security and protection for customers."
- For the level of maturity of market the protections are adequate. These are early adopters who understand what they are doing."
- "I believe that DSF is not well understood by the industry and therefore cannot be understood to any significant level by customers. As a result it isn't clear what safeguarding measures are required."
- "There is a lack of robust information on which customers can base a robust decision about the long-term commercial aspects."
- "No regulation or codes of practice."
- "Currently it is the consumer's choice to participate and it should remain the consumer's choice."



## VULNERABLE CUSTOMERS

Vulnerable customers pose a particular challenge for the transition to a more flexible energy system, as they tend to be less engaged in demand-side measures and may end up the losers to better-off, and better-informed, more engaged neighbours. Asked what is the role of policy and regulation in ensuring vulnerable customers have access to the benefits of a more flexible energy system, respondents cited affordability and the provision of a fair playing field as particular concerns.

Delegates at our DSF working party were vocal in their concerns for vulnerable customers. DNO delegates warned of a very real risk of disadvantaging certain customers. They outlined a potential scenario where, in the same street half the customers are allowed a different, cheaper tariff to their neighbours who are on a constrained part of the network. Such differentiation would be based on geography and take no account of ability to pay.

“Vulnerable customers will require additional support and any policy must account for this.”

**Q:** What is the role of policy and regulation in ensuring that vulnerable consumers have access to the benefits of a more flexible energy system?

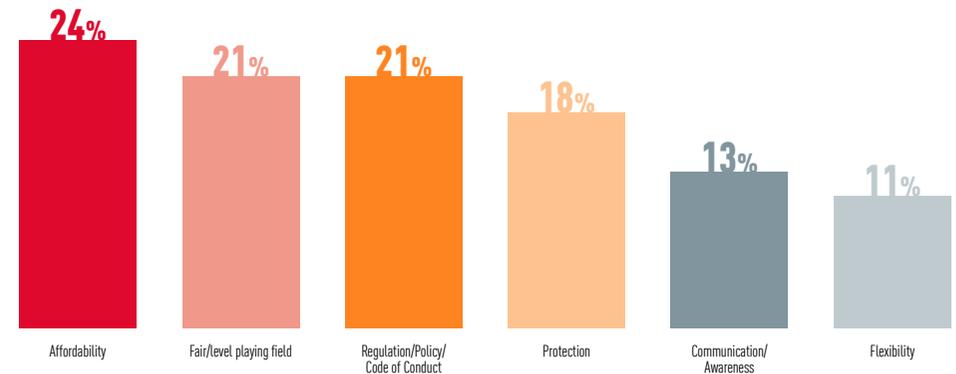


Figure 18

Source: Demand-side flexibility research April 2017

## WHAT IS THE ROLE OF POLICY AND REGULATION IN ENSURING THAT VULNERABLE CUSTOMERS HAVE ACCESS TO THE BENEFITS OF A MORE FLEXIBLE ENERGY SYSTEM?

- ❑ “The role is to ensure that the suppliers have the obligation and economic returns to take the responsibility to install and own the technology rather than only sell technology to customers who can or choose to buy it.”
- ❑ “1) Smart meter rollout with time of use tariffs;  
2) Access to subsidies and financing;  
3) Structured utility programmes that they can participate in.”
- ❑ “Affordability and accessibility.”
- ❑ “The role of policy and regulation must be to allow open access and an honest explanation of the costs and benefits of such a system. Vulnerable customers will require additional support and any policy must account for this. The market will not enable that without direction.”
- ❑ “Ensure there is a level playing field and transparency. Local support groups in communities play an even bigger role in communicating the benefits of a flexible system.”



**A**fter the policy and regulatory context, customer appetite and engagement, technology is the third necessary enabler required for DSF to flourish. Our research showed that technology has a clear role to play, but to varying degrees across the sector.

Overall, energy storage for commercial customers was ranked the most

important technology, at 7.5 out of 10. Grid-connected storage schemes were ranked slightly lower, at 6.9 out of 10, with smart meters and smart appliances coming in at 6.7 and 6.8 respectively.

It is interesting to note that storage technology for domestic customers scored relatively low, at 6.3. Even lower was the importance of the Consumer Access Device interface for smart meters – a technology that many

feel to be outdated before it has even been rolled out – at 5.8. Smart home management devices such as Amazon’s Echo and connected homes apps also scored relatively low at 6 and 6.2 respectively.

More important than any pure play technology was increased awareness of and accessibility to the market for SME and I&C customers, at 7.5 and 7.6 respectively. Technology that facilitates these results will be the clear winner.

## KEY FINDINGS

- ❑ Energy storage for commercial customers was the most important technology in the development of DSF, at 7.5 out of a possible 10.
- ❑ More important than any particular technology was increased awareness of and accessibility to the DSF market for I&C customers.
- ❑ The Consumer Access Device for smart meters and smart home management devices such as Amazon’s Echo were considered to be of limited importance at 5.8 and 6 out of 10 respectively.



**Q:** How would you rate the importance of the following technologies in the development of the DSF market?

	Overall	DNO	Aggregator	Supplier	Trader	Flexibility provider	Other
The Consumer Access Device associated to smart meters	5.8	6.0	4.4	5.3	3.2	4.0	6.6
Smart home management devices such as Amazon’s Echo	6.0	6.4	4.1	6.1	4.3	4.4	6.5
Connected homes apps such as Apple’s recently released app	6.2	6.7	4.0	6.0	3.8	4.4	6.3
Energy storage (domestic)	6.3	6.6	6.3	5.9	5.2	6.0	5.6
Smart meters	6.7	6.3	5.4	7.1	5.8	5.2	6.8
Smart appliances	6.8	7.2	5.6	6.9	5.8	5.6	7.1
Grid-connected storage schemes	6.9	7.8	6.0	7.2	7.2	6.7	7.0
Energy storage (for commercial customers, not including grid-connected storage schemes)	7.5	7.6	8.4	6.9	7.0	7.4	7.6
Increased awareness among SME and I&C customers about DSF opportunities	7.5	8.3	7.1	7.2	7.2	7.1	7.6
Improved accessibility to the DSR market for SME and I&C customers	7.6	8.1	9.0	6.8	6.8	7.7	7.5

Figure 19

Source: Demand-side flexibility research April 2017

**“Energy storage for commercial customers was ranked the most important technology.”**



**The energy sector is committed to DSF in theory, and sees its potential benefits. However, as our research demonstrates, numerous barriers must be overcome for it to realise its full potential.**

Asked for their final thoughts on DSF, respondents' comments included:

- "It is very important that a level playing field is established as soon as possible so that only beneficial DSF is deployed. If this doesn't happen non-beneficial DSF may well be employed in significant quantities only to find its

economic performance crashing once reforms are enacted. This could set back DSF for a very long time."

- "The future will depend on the regulatory decisions made. At present, there seems to be an approach to socialise costs and, as such, to remove the ability of customers to avoid charges – this is one of the biggest drivers of smart behaviour – people are in essence driven by economic drivers. Without them, DSF will be a pointless endeavour unless it's mandated, which would also be hugely unpopular."

- "No single technology will be capable of releasing the potential benefits of DSF. The integration of a range of technologies will be required. At the heart of this will be enhanced monitoring and control of the distribution networks. Industry/government and DNO/DSO/TO/TSO co-ordination will also be critical to realising the potential benefits of DSF. Central to our strategy is the transition from a DNO to a future DSO."
- "DSF will ultimately become a key part of the UK electricity market for the future. The key issues that will determine the speed of rollout are the ability to convince all stakeholders that DSF technology and the appropriate economics are in place via variable, time of use tariffs."
- "It will have a key part to play in the future operation of the energy market."
- "It will be a slow transition and mainly in the non-domestic market."

For the energy sector, a number of things must happen before the potential benefits of DSF can become a reality. First and foremost is policy and regulatory clarity and the removal of significant barriers to operating in the market. The government's response to the smart systems Call for Evidence is expected to set a framework for this, although it has been delayed by the June election. Moreover, our respondents have little confidence that the response will yield the required clarity, suggesting ministers and the regulator will have more work to do.

Meanwhile, increased awareness and engagement of key customer groups is

also required – although this is arguably a 'chicken and egg' situation, with customers unlikely to be interested in the market before it is developed to a point where significant financial incentives can be offered.

Our respondents expected a major uptick in consumer interest around 2024, which is widely expected to be a tipping point in the move towards a more flexible power system. With conventional, flexible generation coming off the grid in the early to mid-2020s, the impact of inflexible renewable generation is likely to be felt in the market, creating price volatility that could make DSF incentives suddenly much more attractive. With the take-up of EVs and electrified heat also expected to accelerate around this time, pressure on the grid will increase and market participants as well as end users will have greater incentives and abilities to engage in DSF. Regulatory reform should be in place by this time, and with RII0-ED2 due to come into force in 2023, networks should be further along the transition towards a DSO model.

In the meantime, despite the undisputed potential benefits of DSF, it remains an unproven and immature market that needs considerable development before reaching mass penetration. Customers, particularly domestic customers, are likely to remain largely unaware of its potential role, and market participants that understand its future significance are left to jockey for position and seek to influence decision makers as its future structure is decided and enshrined in legislation and regulation.



**Rich Hampshire**  
Vice President Utilities,  
CGI UK

**“ In a flexible energy market, consumers will have meaningful choices about how they keep their bills affordable ”**

**T**he terms ‘transformation’ and ‘fundamental’ are much misused. But, for once, it is no understatement that Britain’s energy system is on the brink of the most fundamental transformation since privatisation in 1990 and quite possibly, from an engineering perspective, since the construction of the national grid almost a century ago. The electricity system is undergoing a number of changes, each of which has the potential to be considered transformational in its own right across the spectrum of technology, regulation and consumer experience.

Before looking at the findings, I would like to express our thanks to all those individuals who have invested their time and shared their views to help inform this debate about the shape of Britain’s future energy system.

Any system is only stable within boundaries; and the electricity system has proved to be amazingly resilient as its boundaries have been pushed. In a smart, flexible system, those boundaries extend way beyond the existing ones, at all points across the system. This doesn’t just increase complexity, but when you apply externalities such as the pace of change in the technologies that will become intrinsic parts of the system, then uncertainty compounds the challenge of designing and operating an electricity system that is fit for a low carbon future; of ensuring that we, as consumers, continue to benefit from a system that continues to deliver the level of reliability that we have come to take for granted at a price that doesn’t cost the earth – literally.

Britain is the most deregulated and consistently competitive energy market anywhere in the world. This means (2017 general election results dependent) that the route to an energy system that embraces demand side flexibility at the heart of its operation will be market driven.

This report builds on the findings of the previous report that took a look at the role of flexibility, across all its sources. This year, we have taken a deeper look at the role of demand side flexibility, which incorporates

the role of storage on the demand side. The report shows that, whilst there has been significant activity (the National Infrastructure Commission’s Smart Power report, the BEIS/Ofgem Call for Evidence on a Smart, Flexible Energy System) and the awareness of the significance and scale of the challenge is growing, the market is still in its infancy and confidence that the regulatory and policy barriers will be addressed is low.

As well as providing a deeper understanding of the challenges that face the sector, it also identifies the long term challenges that are at the top of the industry’s leaders’ in trays. This, perhaps, challenges the common perceptions of the sector and shows a picture of a sector that cares deeply about what it does and understands the importance of electricity to its consumers’ lives. The need for appropriate protections to ensure that vulnerable consumers can also benefit from a smarter energy system comes through clearly.

At one level, 2030 may seem a long way away, but if we look back 13 years to the early years of the new millennium, we can see how far we have come. The real challenge is one of timescale. The tipping point is judged to be 2024 when domestic consumer appetite for DSF is expected to rise by 64 per cent. This is unlikely to be a coincidence given this is when the conventional sources or flexibility, such as dispatchable generation, retire from the system and the value of new sources of flexibility will undoubtedly start to grow.

Perhaps the most significant finding in the report is the barriers that need

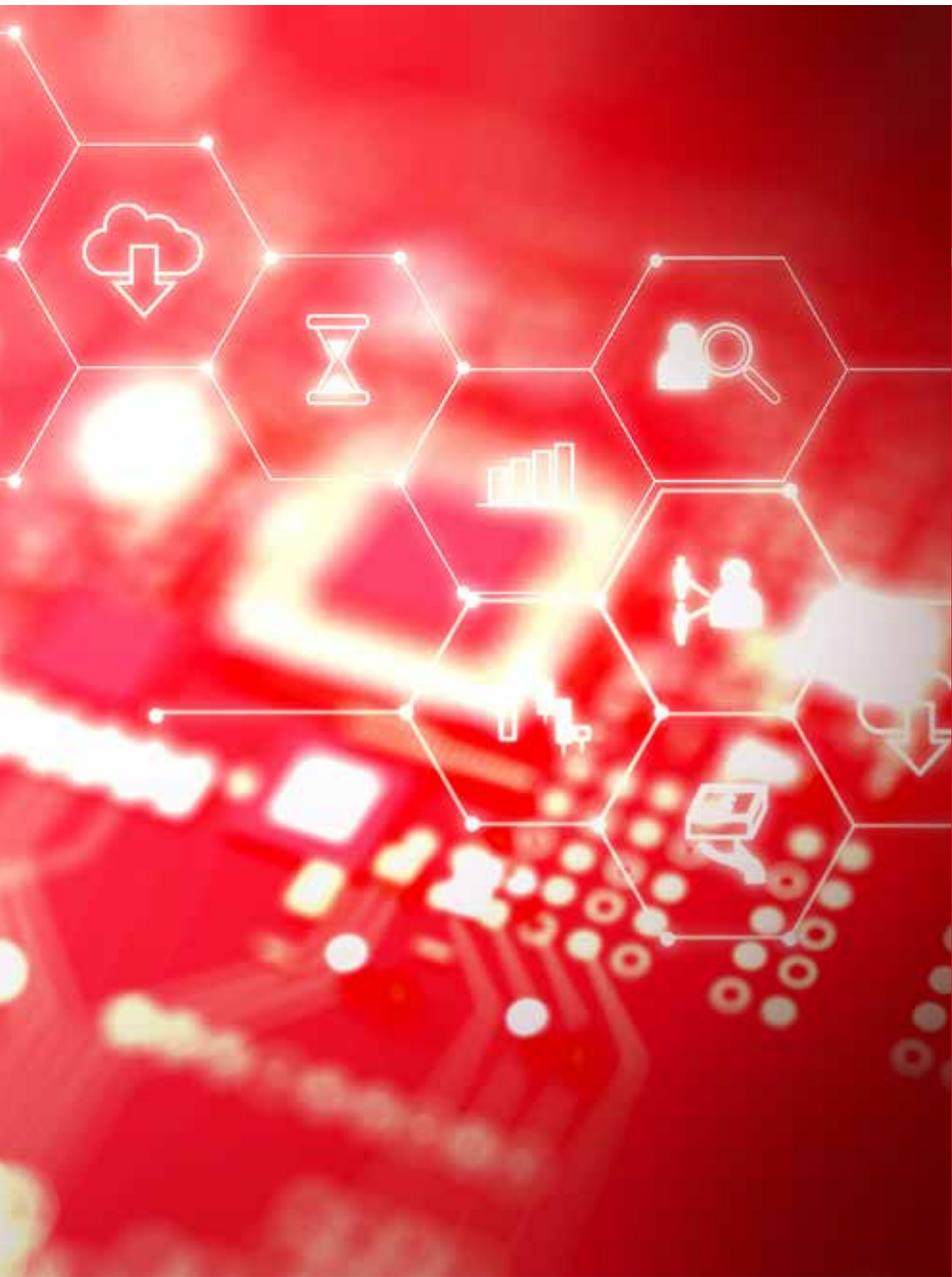
to be addressed if demand side flexibility is to realise its potential to help turn the trilemma into a virtuous circle; one where the adoption of low carbon technologies on the demand side deliver the new sources of flexibility needed to replace the flexibility lost through the growth in renewable generation, and, in a flexible energy market, consumers will have meaningful choices about how they keep their bills affordable. For domestic consumers, the barriers are seen to be a combination of awareness of the solutions and trust in those solutions by addressing privacy and security concerns. For non-domestic consumers, the barriers include a lack of awareness, but also include getting the incentives right.

The report also identifies that embracing new sources of flexibility is broadly seen as an area of new opportunities. The energy traders show the biggest increase in the importance of demand side flexibility to their businesses at 70%, rising from 5.3 today to an importance of 9.0 in 2030.

In the last year Britain has made a start, but this report shows a sector made up of very different roles. It identifies that those different roles don’t fully appreciate each others’ drivers. The understanding of the energy system as a whole by those that are integral to the system looks like it still some way off.

Electricity has become intrinsic to the way we live our lives – from living vicariously through our smart phones to its unseen roles in controlling our heating systems to traffic signals.

To repeat Ellen’s closing remark in her introduction to this report, time is short.



## CGI

### About CGI

Founded in 1976, CGI is one of the world's largest IT and business process services providers, helping clients transform their businesses into digital enterprises. In the Utilities sector, CGI has over 6,000 members worldwide who specialise in providing innovative solutions to our clients' most complex business challenges. CGI has been at the heart of every major change in the UK energy market since privatisation. CGI leads the market in the provision of the technology that enable utility markets to operate effectively. In the UK, we designed, built and continue to operate the BSC Settlement systems for ELEXON; the data systems on behalf of the Data Communication Company (DCC) at the heart of Britain's smart metering implementation programme; and the central market system for Market Operator Services Ltd (MOSL) to support the operation of the non-household English water market. CGI is enabling network operators to make Smart Grids a reality - creating a reliable, economic, sustainable low-carbon energy infrastructure.

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Utility Week was launched in 1994 in response to the growing regulatory and market complexity following utility privatisation. For over 20 years Utility Week has been the UK utility sector's unrivalled thought leader and source of news and comment on the business of Britain's electricity, gas and water sectors. Utility Week provides authoritative analysis, impartial industry intelligence and insight. It has the trust and respect of utility chiefs, regulators and government.



# DEMAND SIDE FLEXIBILITY IN UK UTILITIES

TRANSFORMING THE POWER SYSTEM BY 2030

AN EXCLUSIVE RESEARCH REPORT

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